NOTES ON THE ORIGIN OF THE WAX SECRETION OF CERTAIN COCCINELLID LARVÆ

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The systematic and comparative study of the Coccidæ by modern workers has brought to light many facts regarding the production of wax in scale insects, the types of wax-producing pores and ducts, the function of waxy secretions, and the formation of tassels and tests. The superficial resemblance in life of certain wax-covered Coccinellid larvæ, such as *Scymnus, Cryptolœmus* and *Hyperaspis* to mealy bugs (Coccidæ), leads to an inquiry regarding possible analogies in the origin of the wax. A search of all the available literature failed to produce any satisfactory knowledge. Essig, in describing *Cryptolœmus montrouzieri* larvæ in 1910, mentioned the fact that "the body was covered with white, woolly secretions of various shapes—the covering arranged in long filaments, each filament arising from the dorsal and lateral spine areas and extending in all directions." J. H. Gage, who studied the morphology of the Coccinellid larvæ, devised an elaborate terminology for the parts of the body and arranged tables for the identification and classification of a few of the more common species, but regarding the production of wax, merely stated that the larvæ of the tribe Hyperaspini cover themselves with flocculent masses of waxlike excretion.

The purpose of this paper is to present a few facts and figures regarding the wax-producing pores found in several of the common species of Coccinellids and in an unidentified larva from Central America, all of which were covered in life with masses of white wax and projecting waxy tassels. Figures are also given of the wax-producing ducts found in a common mealy bug, *Pseudococcus gahani* Green.

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According to the Coccinellid terminology devised by Gage, a *struma* is a distinct moundlike projection of the body wall upon which are situated a few *chelazœ,* a *chelaza* being a slight pimplelike projection of the body wall, usually wider than long, and bearing on its distal end a stout seta.

UNKNOWN LARVA FROM CENTRAL AMERICA

This specimen, apparently belonging to the Coccinellini, was taken by quarantine officials at San Francisco on bananas from Central America, and in life resembled a mealy bug in appearance with long lateral tassels of white wax. A prepared slide showed the presence of one struma on the dorso-lateral margins of each thoracic and abdominal segment and two strumæ on the dorso-cephalic margins of the prothorax. The dorsum of the thorax had a fair number of small and medium-sized setæ which were also more sparsely scattered over the dorsum of the abdomen.

Each struma in this species (Fig. 7) bears at the apex one long, fairly stout seta and fifteen or twenty very much smaller setæ, four around the base of the large seta being a little larger than the rest. Surrounding each seta is a band of pores arranged in spherical pattern, six pores surrounding the small setæ (Fig. 2) and sixteen pores surrounding the bases of the large setæ (Fig. 4). All the setæ scattered over the dorsum of the thorax and abdomen have these bands of pores, the number of pores varying from six to twelve, depending on the size of the setæ.

In life this larva was covered with white wax and had long, lateral tassels of wax. The presence of pores on the dorsum indicates that the body wax may be a secretion of these pores and the arrangement of pores around the groups of setæ in the lateral strumæ shows the probable source and production of the long, lateral tassels of wax. The wax is poured from the pores as a fluid, runs out over the setæ and hardens to form filaments.

CRYPTOLÆMUS MONTROUZIERI Mulsant

This well-known species, commonly known as the mealy-bug destroyer, has the body covered with white wax arranged in long tassels on the dorsum and dorso-lateral margins, and with little or no wax on the venter. Early instars, as well as mature larvæ, have this heavy covering of wax. Prepared slides show that the segments of the thorax bear a struma on the dorso-lateral margins and four or five dorsal strumæ arranged in a transverse row, while the abdominal segments, with the exception of the ninth, bear a struma on the dorso-lateral margins and a transverse row of six to eight strumæ on the dorsum. The ninth segment is chitinized and bears numerous long setæ along the margins. The dorsum is covered with many tiny circular pores arranged in more or less circular groups (Fig. 5).

Strumæ.—The strumæ (Fig. 1) in this species are mound-like projections of the body wall bearing ten to fifteen setæ, four or five of which are long and fairly stout while the remainder are somewhat smaller and shorter. A few groups of minute circular pores are scattered among the setæ. There is considerable space between the seta and the alveolus, but there is no group of pores surrounding the seta as in the unknown larva previously described (Fig. 3).

Pores.—The dorsum is covered with groups of very minute pores, each group being somewhat circular in form and consisting of eight to twelve pores forming an outer circle with two or three enclosed pores (Fig. 5). These pore groups are very thickly arranged over the flat derm, but are only sparsely scattered over the elevated strumæ. Wax is probably poured from these hundreds of pores as a fluid and some of it runs out over the long setæ of the strumæ, and hardens to form long, waxy tassels. The production of wax and waxy filaments in *Cryptolæmus montrouzieri* is then probably similar to the production in the unknown Coccinellid larva, the wax in both species being produced from small pores as a fluid and hardening upon associated setæ to form filaments.

HYPERASPIS LATERALIS Mulsant[1]

Pores.—The dorsum is literally covered with many pores which are of two distinct types. One type is tubular, fairly thick-walled with a slightly capitate apex in longitudinal section (Fig. 10), and in cross section is crescent-shaped, indicating that the tube is not completely closed. This form is more numerous and is noticeably larger than the second form and is considerably larger than any of the pores in other Coccinellid larvæ that I have studied. The other type of pore is tubular with the apex slightly chitinous and somewhat knoblike (Fig. 11). Pores of this smaller form are more often found around the bases of the large setæ, although not confined to those areas. The derm is tessellated so that it is divided into small, faintly outlined cells.

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[1] The identification of this species is not certain.

HYPERASPIS MOERENS (Lec.)

Pores.—The dorsal pores of this species are fewer and less conspicuous than in *Hyperaspis lateralis* Mulsant, and are of two types. The more numerous type is very small and indistinct, but appears to be ovate or subovate in shape and the pores are thinly distributed all over the dorsum (Fig. 6). The derm is tessellated and divided into small cell-like plates, each plate having two or a few more pores (Fig. 6). The tessellations fade out in parts of the derm and are not always as distinct as the figure shows. The second type of pore in *H. mœrens* is essentially the same as the tubular, capitate form found in *Hyperaspis lateralis* Mulsant, although they are considerably smaller. Like those in *H. lateralis* they are distributed rather thickly around the bases of the larger setæ.

SCYMNUS NEBULOSUS Le Conte

In this species there are two kinds of dorsal pores, each distinct in appearance and in arrangement. The smaller pores are found close to the strumæ and in the immediate surrounding area (Fig. 14), and they are arranged in more or less circular groups of four or five. Also around each of the larger single dorsal setæ there are ten to fifteen of these small pores, all arranged singly, however, instead of in groups. They seem to be simple, round pores, and are very small, about .5 mm. in diameter or less. There are also many larger, round pores, about 1 or 1.5 mm. in diameter (Fig. 13), which are generally distributed over the dorsum, but are more numerous and closer together along the lateral margins of the body where there is an indication of a cellular arrangement, but which is not as distinct as in *Hyperaspis mœrens* (Lec.).

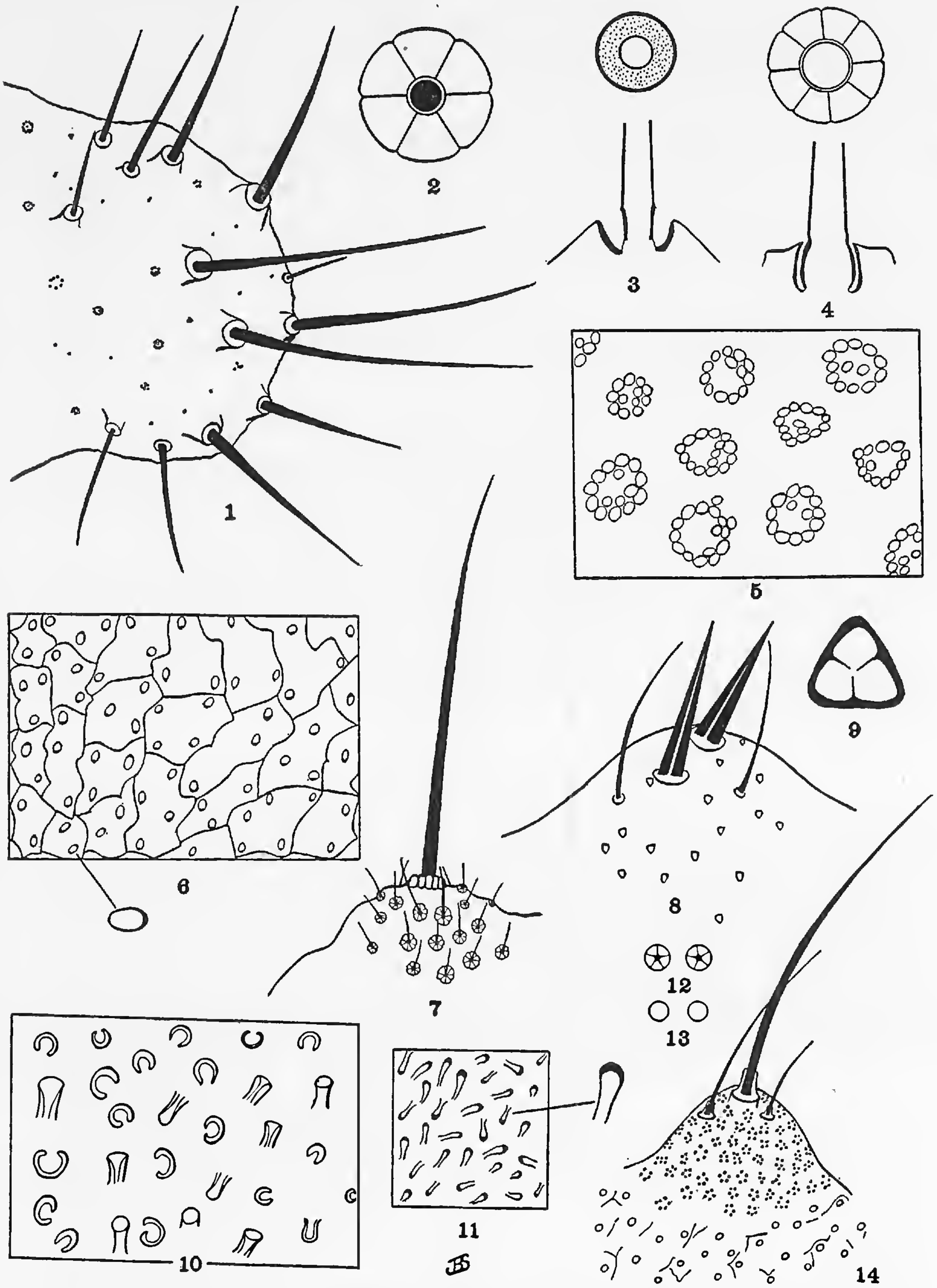
Each struma bears one long, large seta and two shorter slender setæ of unequal size, and they are arranged in a transverse row across each abdominal and thoracic segment, each segment bearing about seven strumæ. The single setæ are more numerous and are variable in size, but are all smaller than the large setæ of the strumæ. In life this species has white wax on the dorsum which is arranged in rather short tassels except on the lateral margins where the tassels are sometimes fairly long.

SCYMNUS GUTTULATUS Le Conte

The arrangement of pores and of strumæ in this species is very similar to that in *Scymnus nebulosus* Le Conte, there being small pores surrounding the strumæ and setæ, and many larger pores all over the dorsum. The smaller pores are the same as the corresponding ones in *nebulosus* (Fig. 12), but the larger pores appear to be compound instead of simple, having four, five or six locelli, usually five, and resemble the stellate pores found in many of the Coccidæ, although they are very much smaller. They are slightly larger than those in *nebulosus,* however, and this may account for the visibility of the locelli, although I have studied specimens of *nebulosus* very carefully under the oil immersion objective and all the pores appeared to be the simple type without locelli. In life the wax on the dorsum is arranged in fairly long tassels, both dorsally and laterally.

It seems probable from the nature of the pores and their arrangement around the strumæ that the wax and waxy filaments in these four latter species is produced in the same manner as described for *Cryptolæmus montrouzieri* and the unknown larva.

Wax of several forms is produced by certain of the scale insects (Coccidæ), and the mealy bugs (Pseudococcinæ) are covered with white wax and wax tassels which give them a resemblance to the wax-covered Coccinellid larvæ. In order to compare the wax-secreting structures of the two groups a cerarius (Fig. 8), and a few wax pores of one of our common mealy bugs is figured. This species, *Pseudococcus gahani* Green, is covered in life with white wax except for four longitudinal rows of conspicuous dots on the dorsum. There are short, stout marginal tassels and a single pair of long, stout, caudal tassels. Among the morphological characters are the presence of seventeen pairs of cerarii, the anterior three or four pairs with three spines, the remainder with only two, those of the anal pair being considerably larger than the others. Each cerarius has numerous triangular pores and several small aux-



1, *Cryptolæmus montrouzieri,* struma; 2, Central American larva, 3, *Cryptolæmus montrouzieri,* strumal seta; 4, Central American larva, large strumal seta; 5, *Cryptolæmus montrouzieri,* section of derm; 6, *Hyperaspis mœrens,* section of derm; 7, Central American larva, struma; 8, *Pseudococcus gahani,* cerarius; 9, *same,* triangular cerarian pore (enlarged); 10, *Hyperaspis lateralis,* section of derm with large pores; 11, *same,* with small pores; 12, *Scymnus guttulatus,* large pores; 13, *Scymnus nebulosus,* large pores; 14, *same,* struma.

iliary setæ. There are a few cylindrical ducts scattered over the derm and many triangular pores (Fig. 9) on the dorsum which secrete the mass of white wax. The liquid wax runs out upon the cerarian setæ and spines to harden and forms tassels, which is probably analogous to the condition in the Coccinellid larvæ. However, the pores are of a different type and size and their arrangement around the lateral setæ is somewhat different, so that there is no true homology. It is evident, therefore, that a very similar appearance in life may arise from morphologically quite different bases.

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A New Codling Moth Parasite

During the month of August 1928 the field inspectors of the Saticoy Walnut Growers' Association observed an ichneumonid which appeared to be attracted to the infested fruit. It was very active and difficult to capture. The first of September fifty immature larvæ from fruit collected at random in one orchard, where the parasite was observed, were brought in to the laboratory and examined. Fifteen had been stung and paralyzed, and on each a large elongate egg had been deposited. The female evidently oviposits through the green tissue of the husk. In one instance a parasitized larva was found in the kernel.

The size of the adults reared varied greatly, due to the variation in the size of the larvæ attacked.

Adults obtained in the field and reared in the insectary were identified by Mr. R. A. Cushman as Calliephialtes n. sp.—Stanley E. Flanders.